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GB 0875323
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(54) Universal joint

(57) A universal joint for a fluid conduit comprises a pair of tubular connectors (1, 2) with cylindrical end portions (3) sealingly secured to the conduit, a bellows (4) sealingly secured within the tubular connectors, these connectors having spherically shaped portions (6, 7) fitting one within the other outside the bellows, a load transmitting sleeve (8), and two pairs of pivots (9, 10) at right angles to each other, with one pair (9) connecting the sleeve and the outer connector portion (6), and the other pair (10) connecting the sleeve and the inner connector portion (7).

The sleeve may be a close sliding fit within the inner connector portion or intermediate the connector portions (6, 7) or on the outer connector portion (as shown) slots (11) being provided in the connector portions as required.

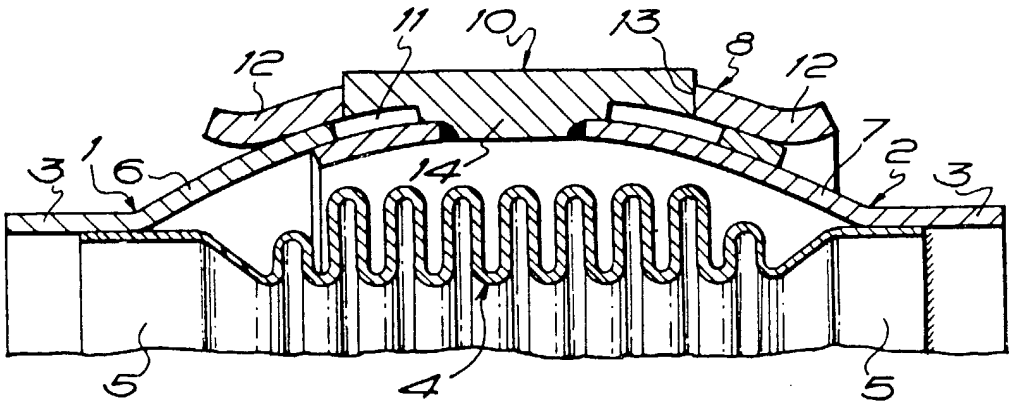

FIG. 2

GB 2 107 816 A

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

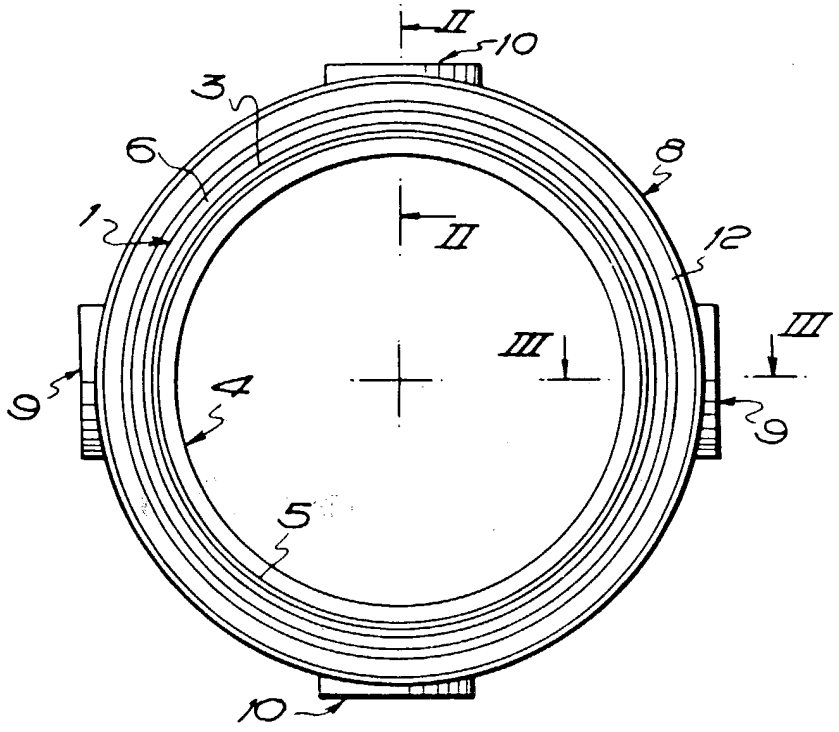

FIG.1

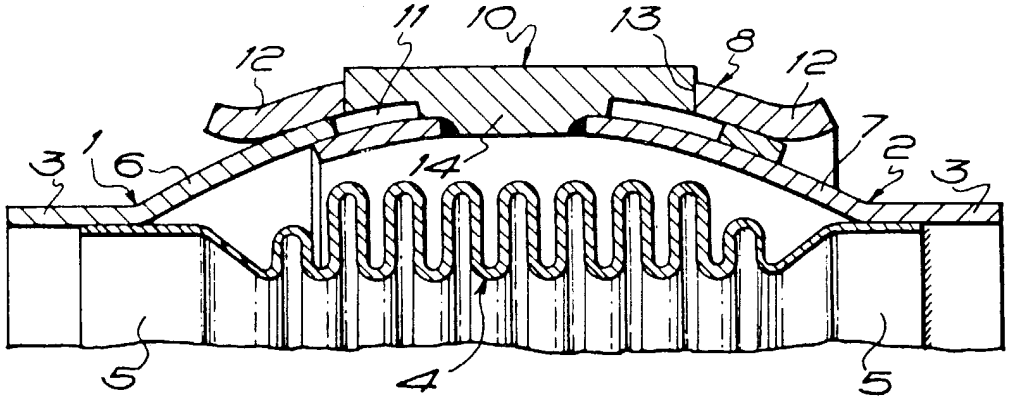

FIG. 2

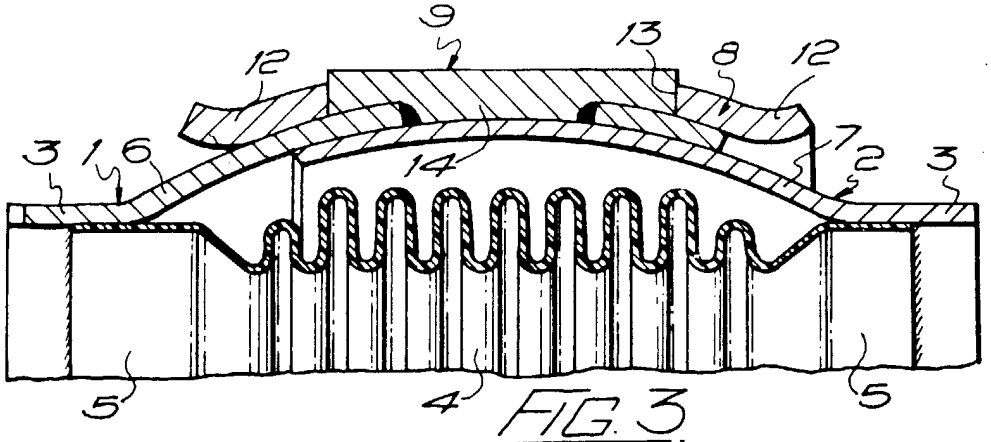

FIG. 3

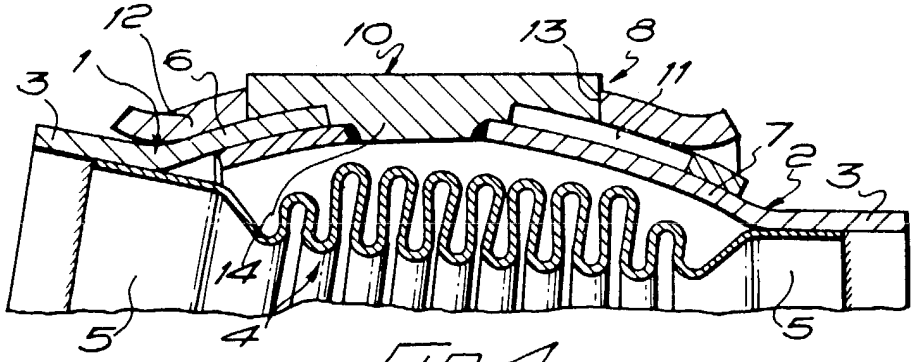

FIG. 4

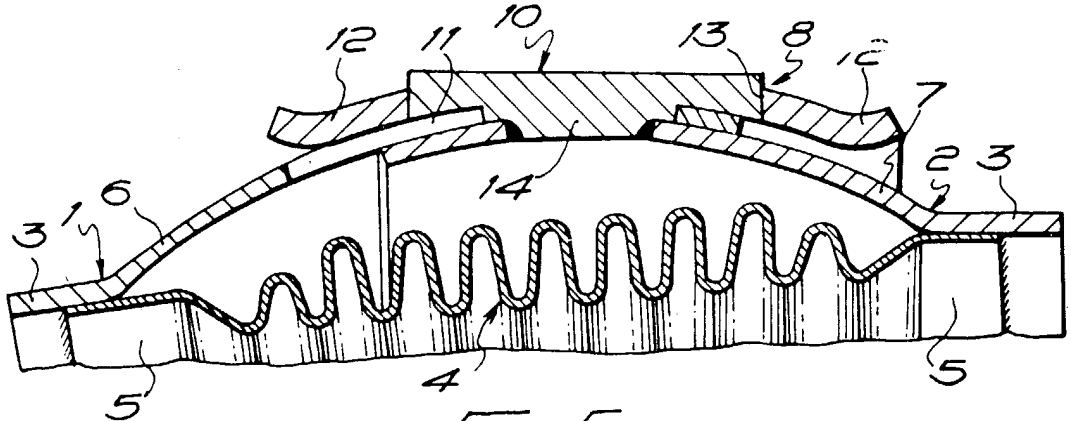

FIG. 5

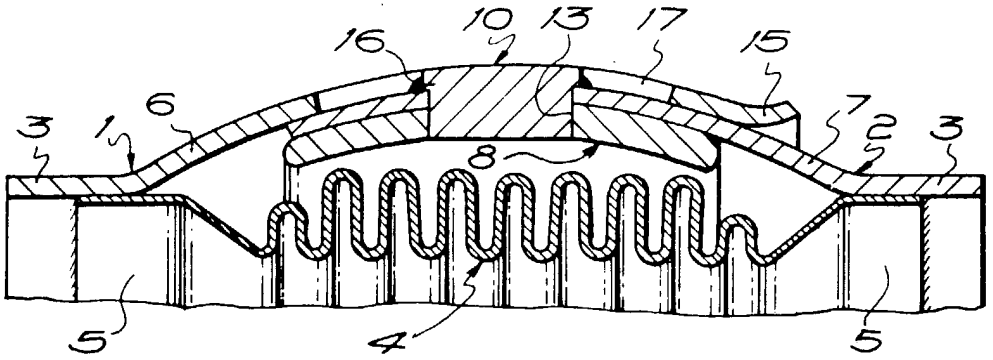

FIG. 6

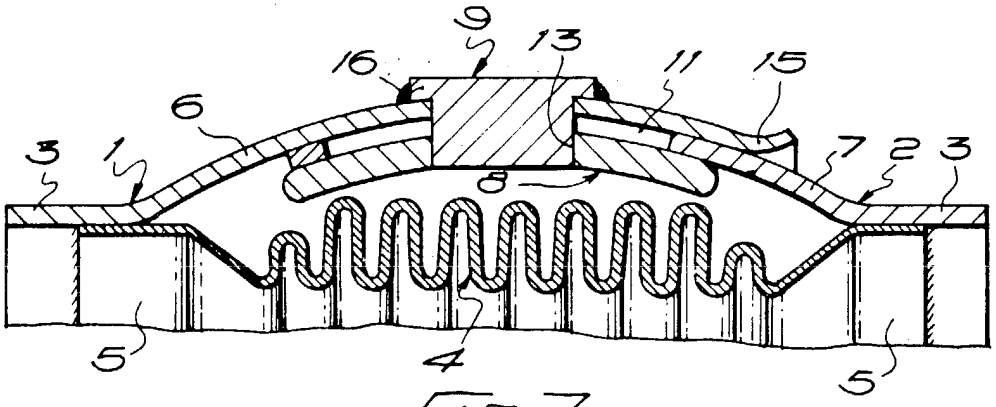

FIG. 7

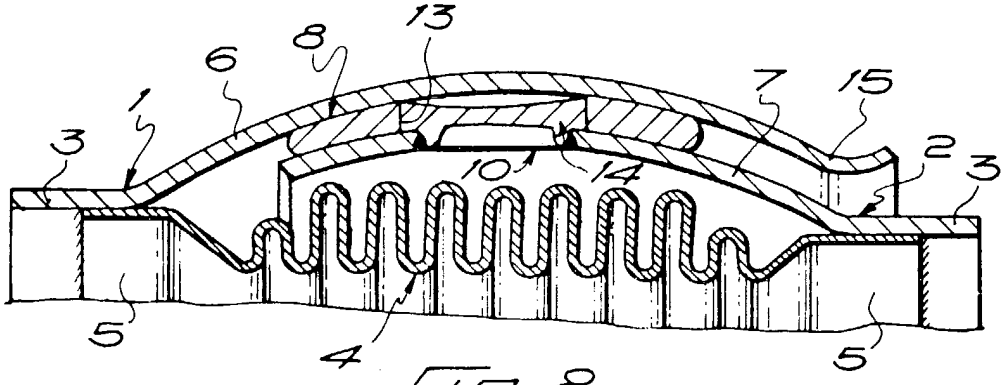

FIG. 8

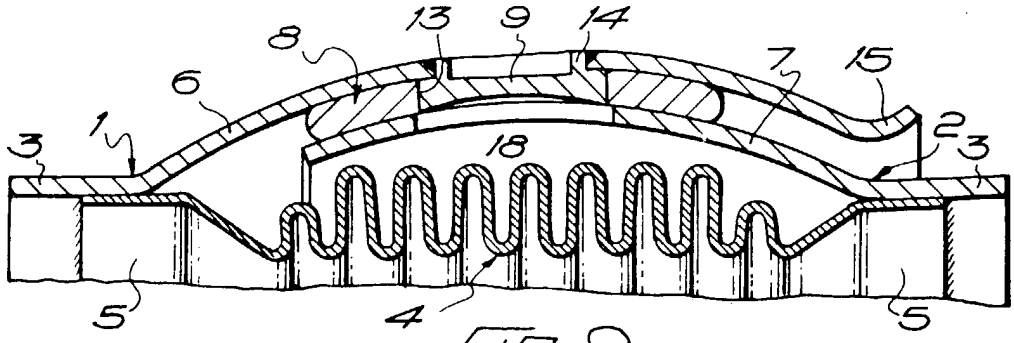

FIG. 9

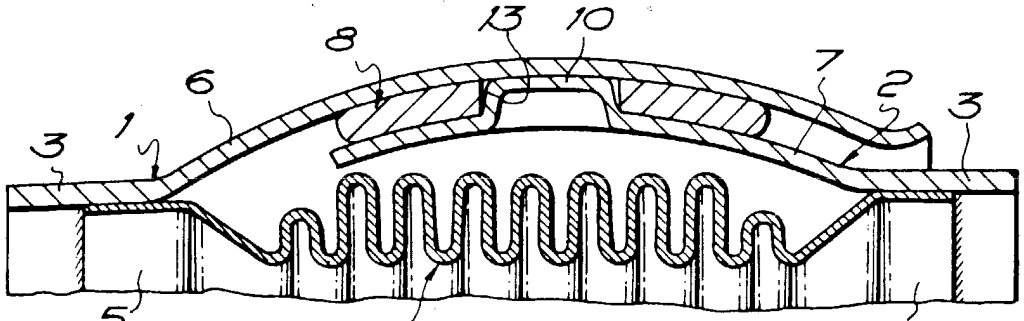

FIG. 10

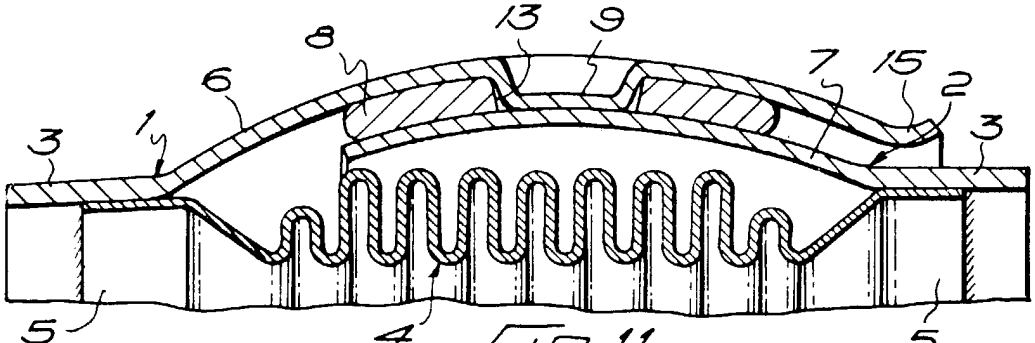

FIG. 11

S-S

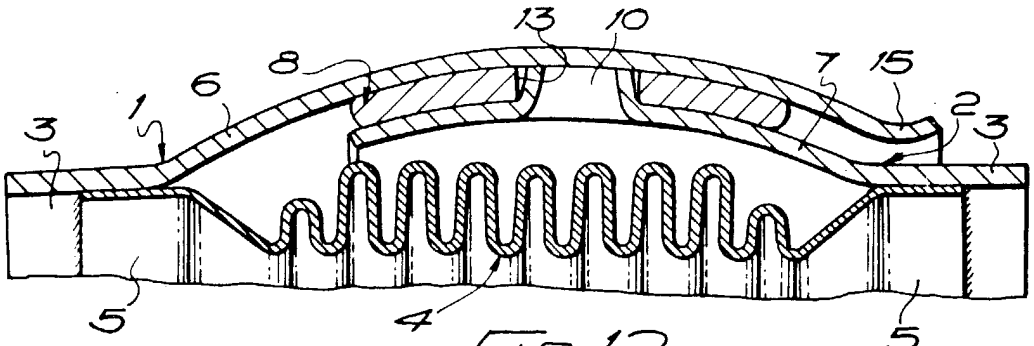

FIG. 12

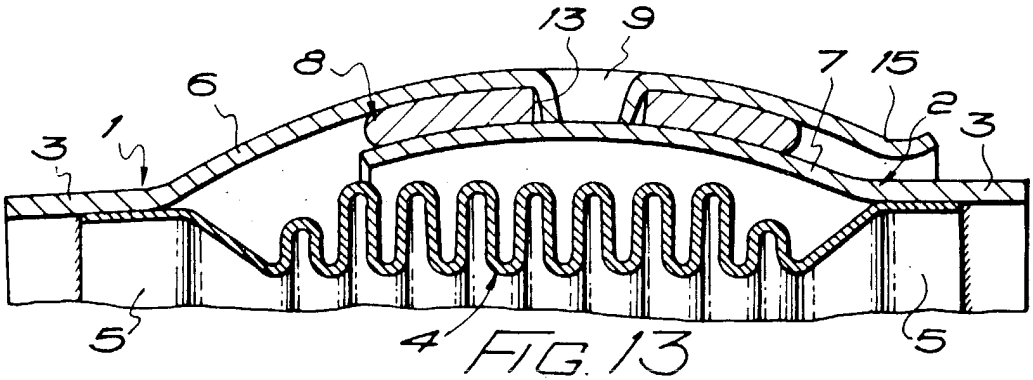

FIG. 13

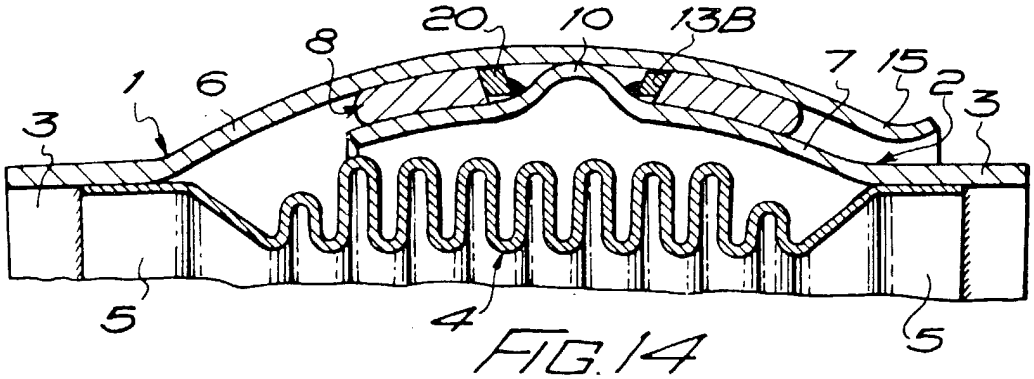

FIG. 14

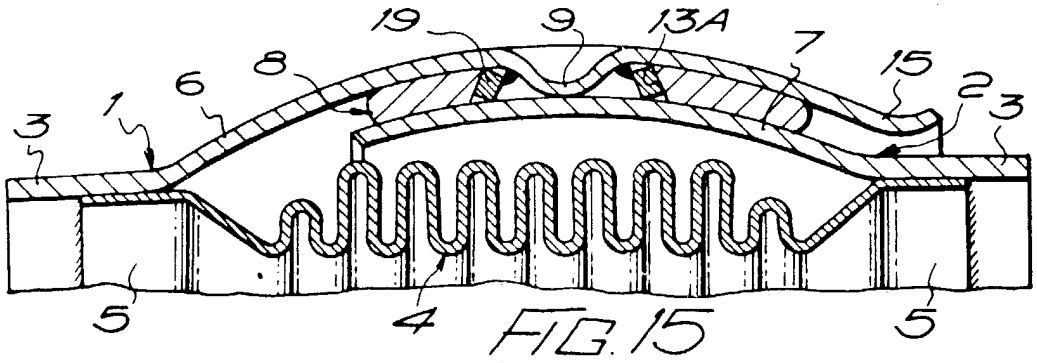

FIG. 15

SPECIFICATION
Universal joint

This invention relates to a universal joint for a fluid conduit and particularly to a bellows sealed universal joint capable of angulating through 360°, such as is used in a pipe or ducting carrying a fluid, particularly air, for example ducted hot air in an aircraft, to cater for thermal expansion, installation tolerances and vibration.

When an internal pressure is applied to the bellows an end load is produced which must be restrained to prevent stretching of the bellows and damage to adjacent structures. Therefore, it is known to sealingly secure cylindrical ends of the bellows in respective tubular connectors adapted to be sealingly secured to two adjacent parts of the conduit, and to provide externally of the tubular connectors means for transmitting end load between the connectors whilst allowing the connectors to angulate through 360°.

In one known form of universal joint of this type, which is widely used in aircraft, the external load transmitting means comprises a ring with two pairs of diametrically opposed pins at right angles to each other, one pair of pins serving as pivotal connections with one tubular connector and the other pair of pins serving as pivotal connections with the other tubular connector, and the adjacent ends of the tubular connectors are profiled to afford sufficient clearance between them to permit angulation through 360°. The disadvantage of this form of universal joint is that the profiled annular gap between the tubular connectors allows ingress of dust and debris which may restrict the freedom of the bellows, and, in the event of leakage of the bellows, allows egress of fluid rapidly from the joint.

Therefore, in another known form of universal joint of the bellows sealed type, which has recently been adopted in aircraft and is described in U.K. Patent Application 2,029,537A, the tubular connectors are formed with spherically shaped portions slidingly interfitted one within the other outside the bellows to form a "knuckle joint" capable of angulating through 360°, and the external load transmitting means comprises a sleeve extending beyond both interfitted portions and provided with bearing means between end portions of the sleeve and the respective connectors, the bearing means comprising, for each connector, diametrically oppositely disposed pivotable connections, with the pivotable connections of one of the connectors angularly displaced by 90° from such connections on the other connector. The sleeve and the interfitted, spherically shaped portions of the connectors serve to prevent ingress of dust and debris to the bellows, and close interfitting of the spherically-shaped portions of the connectors greatly restricts egress of fluid from the joint in the event of leaking of the bellows. In one embodiment the pivotable connections are formed by interengaging curved flanges on brackets secured respectively on the sleeve and on the respective connectors, and two pairs of diametrically opposed inwardly directed pins at right-angles to each other are secured to the sleeve and extend, with clearance, into apertures in the interfitted portions of the connectors to assist angulation. The disadvantage of this form of universal joint is that it has a large number of parts which add considerably to its weight and cost, including complications in assembling it.

The object of the invention is to provide a bellows sealed universal joint capable of angulating through 360° without having the disadvantages of the known forms referred to above.

According to the present invention, a universal joint for a fluid conduit comprises a pair of tubular connectors with cylindrical end portions adapted to be sealingly secured to two adjacent parts of the conduit, a bellows with respective cylindrical ends sealingly secured within the cylindrical end portions of the tubular connectors, which are also formed with spherically shaped portions fitting one within the other outside the bellows, a spherically shaped load transmitting sleeve, and two pairs of diametrically opposed pivots at right angles to each other, with one pair of pivots connecting the sleeve and the outer spherically shaped connector portion, and with the other pair of pivots connecting the sleeve and the inner spherically shaped connector portion.

The load transmitting sleeve may be a close sliding fit within the inner spherically shaped connector portion or intermediate the spherically shaped connector portions or on the outer spherically shaped connector portion.

If the load transmitting sleeve is a close sliding fit within the inner spherically shaped connector portion or on the outer spherically shaped connector portion, one pair of pivots will require axially extending slots in the inner or outer spherically shaped connector portion (as the case may be) in order to connect the load transmitting sleeve in a load carrying manner to the outer or inner spherically shaped connector portion and to allow relative sliding between the connector portions in the regions of those pivots as angulation of the joint takes place about the other pair of pivots. However, the slots will normally be closed by the load transmitting sleeve either internally or externally.

If, on the other hand, and as is preferred, the load transmitting sleeve is a close sliding fit intermediate the spherically shaped connector portions, no such slots are required. The load transmitting sleeve is preferably formed of thicker material (e.g., stainless steel) than the tubular connectors, the inner connector portion being spun out in situ until it is a close sliding fit within the load transmitting sleeve, which is fixed on the inner connector portion by means of one pair of pivots, and the outer connector portion then being spun down in situ until it is a close sliding fit on the load transmitting sleeve, which is fixed within the outer connector portion by the other pair of pivots. The free end of the outer connector portion

preferably extends beyond the respective end of the load transmitting sleeve and is preferably flared. The other end of the load transmitting sleeve is preferably coterminous with the free end of the inner spherically shaped connector portion when the tubular connectors are in axial alignment. The spinning down of the outer tubular connector is preferably interrupted before its cylindrical end portion reaches an internal diameter equal to the overall external diameter of the bellows, the bellows then being inserted from that end and the other end of the bellows welded to the cylindrical end portion of the inner tubular connector, whereafter the spinning down of the outer tubular connector is continued until its cylindrical end portion has an internal diameter enabling the adjacent end of the bellows to be welded to it.

The pivots may be separate members secured to the intermediate load transmitting sleeve, or (preferably) to the respective spherically shaped connector portions, as by welding flanges or spigots on the separate members to the sleeve or (preferably) to the connector portions. The inner spherically shaped connector portion may be provided with a pair of holes affording access for inserting into the sleeve the separate pivot members for the outer spherically shaped connector portion.

Alternatively, the pivots may be formed integral with the respective spherically shaped connector portions, as by pressing dimples or lipped holes, e.g. two inwardly and two outwardly, extending into holes in the spherically shaped sleeve.

Again, the pivots may be formed by a combination of dimples in the respective spherically shaped connector portions and rings welded to the respective spherically shaped connector portions concentric with the dimples, with the rings fitting into holes in the load transmission sleeve. The outsides of the rings and the insides of the holes may be frusto-conical, whereby the rings must be fitted in the holes before being welded to the respective spherically shaped connector portions, one of which is provided with a pair of holes to permit welding of the rings of the other connector portion around the dimples of the latter.

A number of embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:—

Figure 1 is an end elevation of a universal joint for a fluid conduit and in accordance with the invention;

Figures 2 and 3 are enlarged fragmentary sections on the lines II—II and III—III respectively of Figure 1;

Figures 4 and 5 each correspond to Figure 2 but show the connector portions angled at the respective extreme positions with respect to each other;

Figures 6 and 7 correspond to Figures 2 and 3 but relate to another embodiment of universal joint in accordance with the invention;

Figures 8 and 9 also correspond to Figures 2 and 3 but relate to a particularly preferred embodiment of the invention;

Figures 10 and 11 correspond to Figures 8 and 9 but show pivots formed integrally with the connector portions;

Figures 12 and 13 also correspond to Figures 8 and 9 but show an alternative way of forming the pivots integrally with the connector portions; and

Figures 14 and 15 likewise correspond to Figures 8 and 9 but show another way of providing the pivots.

In Figures 1 to 3, a universal joint for a fluid conduit comprises a pair of tubular connectors 1, 2 with cylindrical end portions 3 adapted to be sealingly secured to two adjacent parts of a conduit (not shown), a bellows 4 with respective cylindrical ends 5 sealing secured within the cylindrical end portions 3 of the tubular connectors 1, 2 which are also formed with spherically shaped portions 6, 7 fitting one within the other outside the bellows 4, a spherically shape load transmitting sleeve 8, and two pairs of diametrically opposed pivots 9, 10 respectively at right angles to each other, with one pair of pivots 9 connecting the sleeve 8 and the outer spherically shaped connector portion 6, and with the other pair of pivots 10 connecting the sleeve 8 and the inner spherically shaped connector portion.

The load transmitting sleeve 8 is a close sliding fit on the outer spherically shaped connector portion 6 and so slots 11 (Figure 2) are provided in that outer connector portion for the pivots 10 in order to allow for relative sliding between the connector portions 6, 7 in the regions of the pivots 10 (as shown in Figures 4 and 5) as angulation of the joint takes place about the other pair of pivots 9. However, the slots 11 will normally be closed by the load transmitting sleeve 8. The ends 12 of the load transmitting sleeve 8 are flared so as not to make sharp contact with the respective cylindrical end portions 3 of the connectors 1, 2 when the joint is angulated to its maximum extent about either or both pairs of pivots 9, 10. The pivots 9, 10 are separate members fitting holes 13 in the load transmission sleeve 8 and secured to the respective connector portions 6, 7 by welding spigots 14 thereto.

In Figures 6 and 7 (and also in the succeeding pairs of Figures) like numerals represent like parts to those shown in Figures 1 to 5, but in this case the load transmitting sleeve 8 is a close sliding fit within the inner spherically shaped connector portion 7 and so slots 11 (Figure 7) are provided in that the inner connector portion for the pivots 9 in order to allow for relative sliding between the connector portions 6, 7 in the regions of the pivots 9 as angulation of the joint takes place about the other pair of pivots 10. The free end 15 of the outer connector portion 6 is flared. The pivots 9, 10 are again separate members fitting holes 13 in the sleeve 8 but are secured to the respective connector portions 6, 7 by welding flanges 16 thereto, and — in consequence — the outer

connector portion 6 is provided with slots 17 (Figure 6) to accommodate the flanges 16 of the pivots 10 and allow for relative sliding between the connector portions 6, 7 in the regions of the pivots 10 as angulation of the joint takes place about the other pair of pivots 9.

In Figures 8 and 9 the load transmitting sleeve 8 is a close sliding fit intermediate the spherically shaped connector portions 6, 7 so no slots are required in either of them. The free end 15 of the outer connector portion 6 extends beyond the respective end of the load transmitting sleeve 8 and is flared. The inner spherically shaped connector portion 7 is provided with a pair of holes 18 (Figure 9) affording access for inserting into the sleeve 8 the separate pivot members 9 for the outer spherically shaped connector portion 6.

In Figures 10 and 11 the load transmitting sleeve 8 is again intermediate the connector portions 6, 7 (as is also the case with the final pairs of Figures) but the pivots 9, 10 are formed integral with the respective connector portions by pressing dimples, two inwardly (Figure 11) to form the pivots 9 and two outwardly (Figure 10) to form the pivots 10, while in Figures 12 and 13 the pivots 9, 10 are formed integrally by pressing (or piercing) lipped holes in the connector portions 6, 7, two inwardly (Figure 13) and two outwardly (Figure 12).

In Figures 14 and 15 the pivots 9, 10 are formed by a combination of dimples in the respective connector portions 6, 7 and rings 19, 20 welded to the respective connector portions concentric with the dimples, with the rings fitting into holes 13A, 13B in the load transmission sleeve 8, the outsides of the rings 19, 20 and the insides of the holes 13A, 13B being frusto-conical, whereby the rings must be fitted in the holes before being welded to the respective spherically shaped connector portions, the inner connector portion 7 being provided with a pair of holes 21 to permit the rings 19 to be welded around the dimples 9 in the outer connector portion 6.

CLAIMS

1. A universal joint for a fluid conduit comprising a pair of tubular connectors with cylindrical end portions adapted to be sealingly secured to two adjacent parts of the conduit, a bellows with respective cylindrical ends sealingly secured within the cylindrical end portions of the tubular connectors, which are also formed with spherically shaped portions fitting one within the other outside the bellows, a spherically shaped load transmitting sleeve, and two pairs of diametrically opposed pivots at right angles to each other, with one pair of pivots connecting the sleeve and the outer spherically shaped connector portion, and with the other pair of pivots connecting the sleeve and the inner spherically shaped connector portion.

2. A universal joint as in Claim 1, wherein the load transmitting sleeve is a close sliding fit within the inner spherically shaped connector portion, and axially extending slots are provided in the inner spherically shaped connector portion for the pivots of the outer spherically shaped connector portion.

3. A universal joint as in Claim 1, wherein the load transmitting sleeve is a close sliding fit on the outer spherically shaped connector portion, and axially extending slots are provided in the outer spherically shaped connector portion for the pivots of the inner spherically shaped connector portion.

4. A universal joint as in Claim 1, wherein the load transmitting sleeve is a close sliding fit intermediate the spherically shaped connector portions.

5. A universal joint as in any one of Claims 1 to 4, wherein the load transmitting sleeve is formed of thicker material than the tubular connectors.

6. A universal joint as in any one of Claims 1 to 5, wherein the pivots are separate members secured to the intermediate load transmitting sleeve.

7. A universal joint as in any one of Claims 1 to 5, wherein the pivots are separate members secured to the respective spherically shaped connector portions.

8. A universal joint as in Claim 6 or Claim 7, wherein the separate pivot members have flanges for securing them by welding.

9. A universal joint as in Claim 6 or Claim 7, wherein the separate pivot members have spigots for securing them by welding.

10. A universal joint as in Claim 7, wherein the inner spherically shaped connector portion is provided with a pair of holes affording access for inserting into the sleeve the separate pivot members for the outer spherically shaped connector portion.

11. A universal joint as in any one of Claim 1 to 5, wherein the pivots are formed integral with the respective spherically shaped connector portions.

12. A universal joint as in Claim 11, wherein the pivots are formed by pressing dimples extending into holes in the spherically shaped sleeve.

13. A universal joint as in Claim 11, wherein the pivots are formed by pressing lipped holes extending into holes in the spherically shaped sleeve.

14. A universal joint as in any one of Claims 1 to 5, wherein the pivots are formed by a combination of dimples in the respective spherically shaped connector portions and rings welded to the respective spherically shaped connector portions concentric with the dimples, with the rings fitting into holes in the load transmission sleeve.

15. A universal joint as in Claim 14, wherein the outsides of the rings and the insides of the holes are frusto-conical, and so the rings are fitted in the holes before being welded to the respective spherically shaped connector portions, one of which is provided with a pair of holes to permit welding of the rings of the other connector portion

around the dimples of the latter.

16. A universal joint for a fluid conduit substantially as hereinbefore described with reference to Figures 1 to 5 or any one of the pairs of Figures 6 and 7, 8 and 9, 10 and 11, 12 and 13, or 14 and 15 of the accompanying drawings.

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